Newsletter of the Seismological Association of Australia Inc. Quarter 4, 2021

Seismological Association of Australia Inc.

Welcome to the Newsletter of the
Seismological Association of Australia Inc.
PO Box 682, Mylor SA 5153

Membership of the SAA is open to all, with the only prerequisite being an interest in seismology. Membership applies for the calendar year. (January through to December)

Membership fees are: Full member $50

A Membership application form can be obtained from the Treasurer by email or you may download it here.

Member Submissions

Submissions for inclusion in the Newsletter are welcome from all members; please note that submissions may be held over for later editions. Wherever possible, text submissions should be sent via email in almost any word processing format. Images should be high resolution and uncompressed, although high resolution JPEGs are acceptable. Your name may be withheld only if requested at the time of submitting.

All enquiries and submissions should be addressed to the Editor and preferably sent by email to weaksignals@iinet.net.au

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The SAA can be contacted by post to the address above, or by email to any member of the Committee.

SAA News

2021 SAA Annual General Meeting - The AGM will be held on Monday, October 21st at 7:30pm ACST, 8:00pm AEST and 12:00 UT. via ZOOM. All members should have recently received an invitation and link to attend, please advise the Secretary if not and he will send it again.
Agenda items include the Chairman's report, Secretary's report, Treasurer's Financial report and the Chief Seismologist's report.
A great line-up of interesting material and speakers include David Love - How good are our magnitudes?, the recent Wood's Point M5.8 quake - Abraham Jones (Melbourne Uni) - Aftershock deployment / David Love, Kevin McCue, Gary Gibson - Other aspects of the earthquake.
The all important Election of Committee Members - All committee positions will be declared vacant at the AGM and elections will be held to fill the positions of: Chairperson, Secretary, Treasurer, Public Officer, Chief Seismologist, Newsletter Editor & Committee Member.

Science Alive 2021 - Science Alive in Adelaide has been rescheduled to 19th-22nd of November. Further details on the event will be emailed to Adelaide/SA members and other interested members in a week or two.

Station Upgrades - After doing the rounds with the latest Week Number Rollover issues, there were some batteries to replace and more work at TPSO. A rare opportunity to visit HML1 came about from a failing battery. Many peope may have heard of Hamley Bridge but very few have actually been there. It was an opportunity to remove some obsolete equipment and reorganise. The cover image shows David Love alongside the covered seismic pit. On page 4 there are before and after images of the HML1 internals, following David & Blair's visit.
The Lippmann High-Resolution Tiltmeter (HRTM) has returned from Europe and recently been reinstalled at TPSO following some modifications by Mr Erich Lippmann. You can find the data at the GGKI Earth Physics & Space Research webpage, look for the LTS_HTRM1_*_TPSO tabs. The instrument is still stabilising to the TPSO's vault temperature so the X & Y downward drift should slowly level out sometime soon.
While we're patting ourselves on the back for this instrument's performance, spare a thought for our magetometer. A pair of the Magson MFG-1S's space hardened siblings, recently flew by Mercury in a 7 year mission aboard the Mercury Magnetospheric Orbiter, part of the ESA-JAXA BepiColombo mission. The instrument's owner, Markus Wiedemann, was responsible for the FPGA design, the onboard flight software and testing of both.

Wobbly Buildings Part II - Following the positive results of the SAA's first attempt at building monitoring, David Love has been in contact with representatives of the University of Adelaide to find and access another trial site. Adelaide Uni has offered us access to the Schulz building (12 levels & roof) as the second monitoring site and a plan has been devised to carry it out with multiple sensors/recorders positioned in the same locations at different levels. The exercise will take a day or so to complete with a small team of SAA members onsite to move the instruments/recorders between levels. We are just waiting for a windy day.

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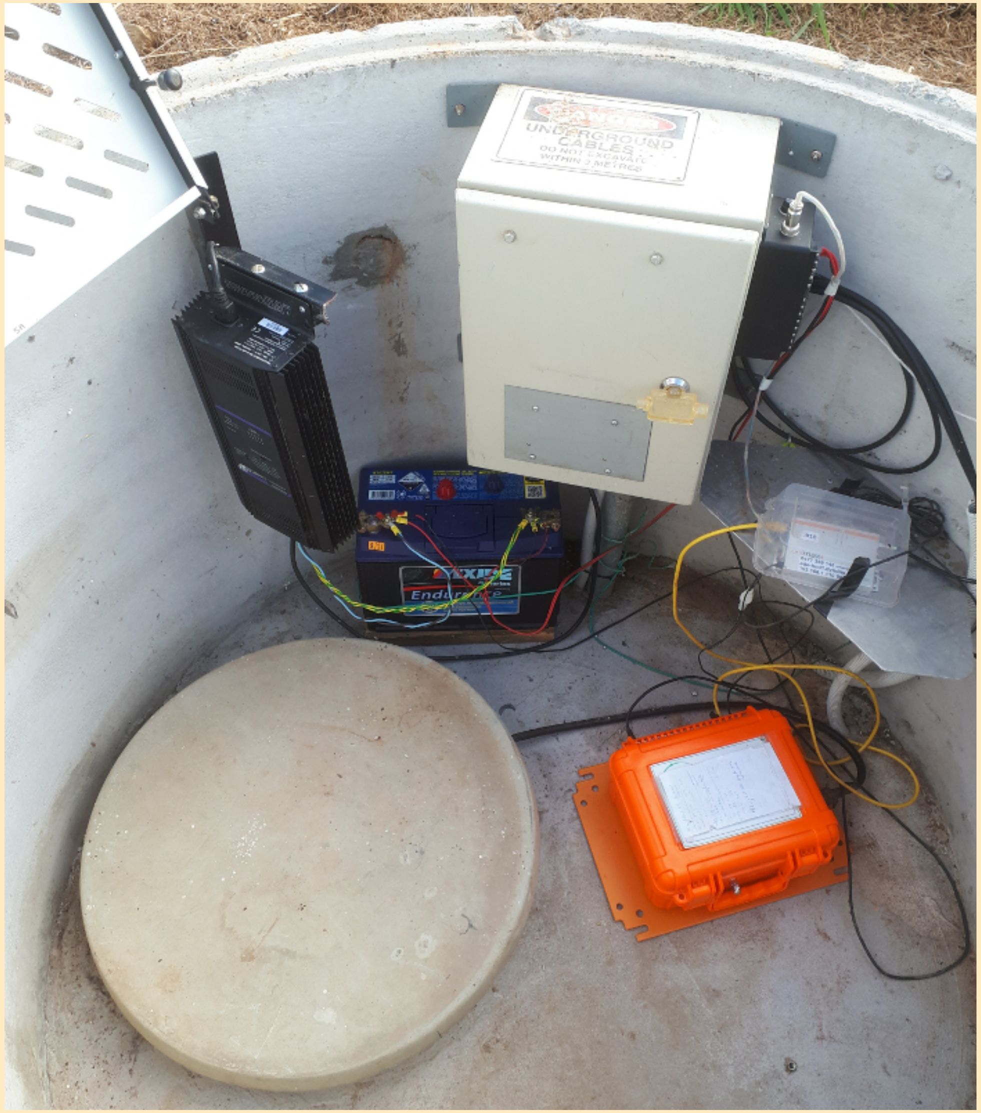
HML1 gets a makeover

Before



After

The 'T' phase in Australia

Kindly submitted by Kevin McCue, CQSRG
and David Love, SAA Chief Seismologist

Primary, Secondary and Tertiary phases; it is surprising the so-called 'T' phase acquired such prominence, up there with P and S. Observers from southeast Queensland to Tasmania (Ripper and Green, 1966) record them infrequently, a fairly monotonic 0.8Hz modulated coda following shallow earthquakes off the southwest of New Zealand or South America. Sometimes, especially at Macquarie Island the direct wave and a wave reflected from submarine ridges is observed which makes for a complicated seismogram. They are probably not so common in South Australia, the NZ path being shielded by Tasmania but they should be generated by moderate earthquakes on the mid-ocean ridge south of Australia. There is a conversion at the continental shelf of T to P which can then travel quite some distance from the coast. Ripper and Green computed a P wave velocity of 5.9km/s from the converted wave observed across the Tasmanian seismograph network. The convention is to measure the T arrival time from the peak of the modulated coda rather than the emergent commencement as with P and S phases.

T waves are a guided wave, travelling through the SOFAR channel at about 1km depth with a velocity of near 1.5km/s. They are interesting but not used for locating the epicentre, or for anything else for that matter.

Whilst throwing out papers I came across a paper by Burke-Gaffney S.J. (1954) which triggered this note. It was labelled Riverview College Observatory Geophysical Papers No. 6. At that time the mode of propagation was disputed.

So keep your eyes out for this characteristic but infrequent wave.

On the following page, Figure 1 shows an example of a T phase recorded across the SA network on 2019-08-21 at 1428UT. The T phase comes about 15 minutes after the P, and the S phase is not visible. Figure 2 shows the ISC location of the event (star) on the mid-ocean ridge (faint east-west feature) and the transform fault (north-south feature), and the recording stations (triangles).

References

Burke-Gaffney, T.N., 1954. The T-Phase from the New Zealand Region. J. Proc. Roy. Soc. NSW, V87-88. pp51-54.
https://www.biodiversitylibrary.org/page/46423200#page/356/mode/1up

Ripper I., & Green R., 1966. Tasmanian examples of the influence of bathymetry and crustal structure upon seismic T-wave propagation.
https://doi.org/10.1080/00288306.1967.10420213

The ’T’ phase in Australia

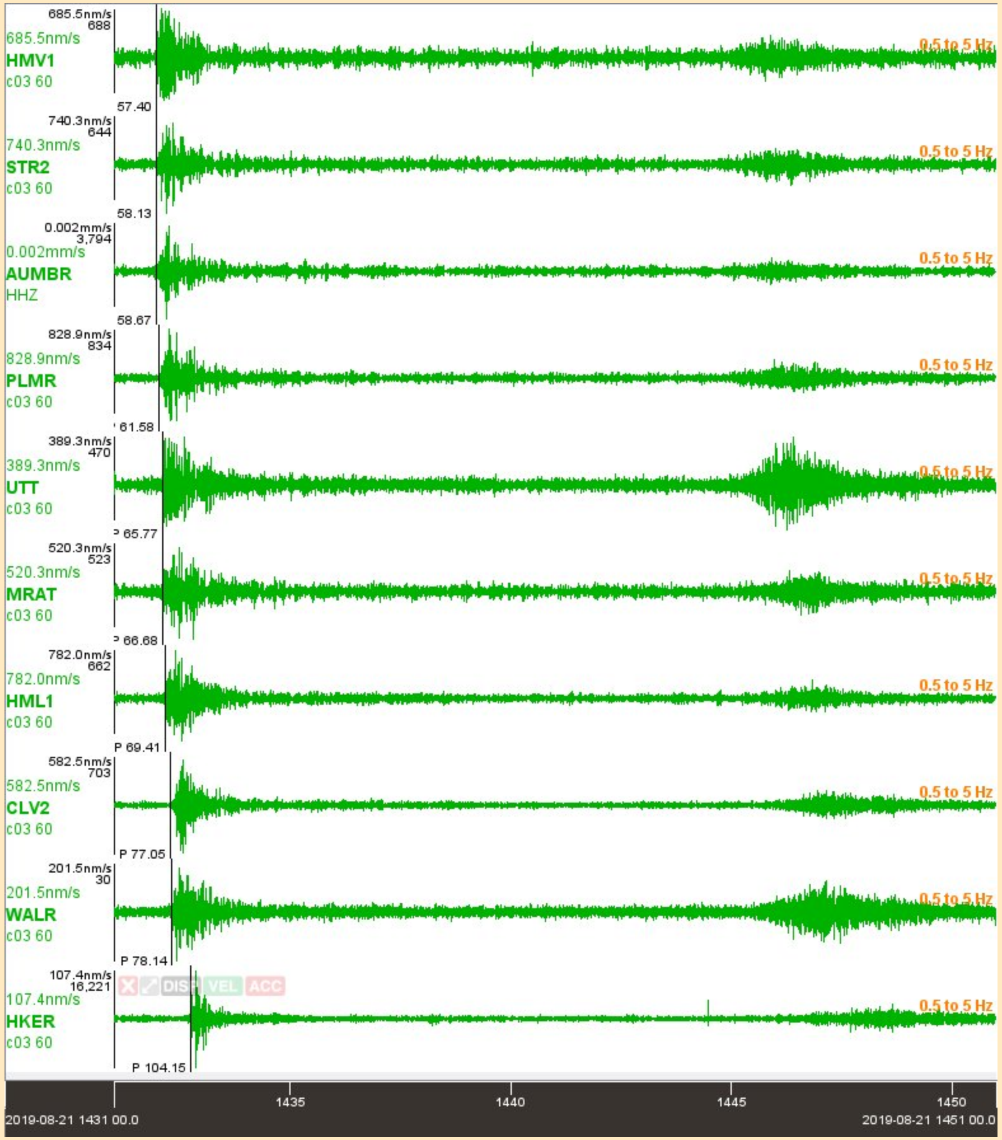


Figure 1

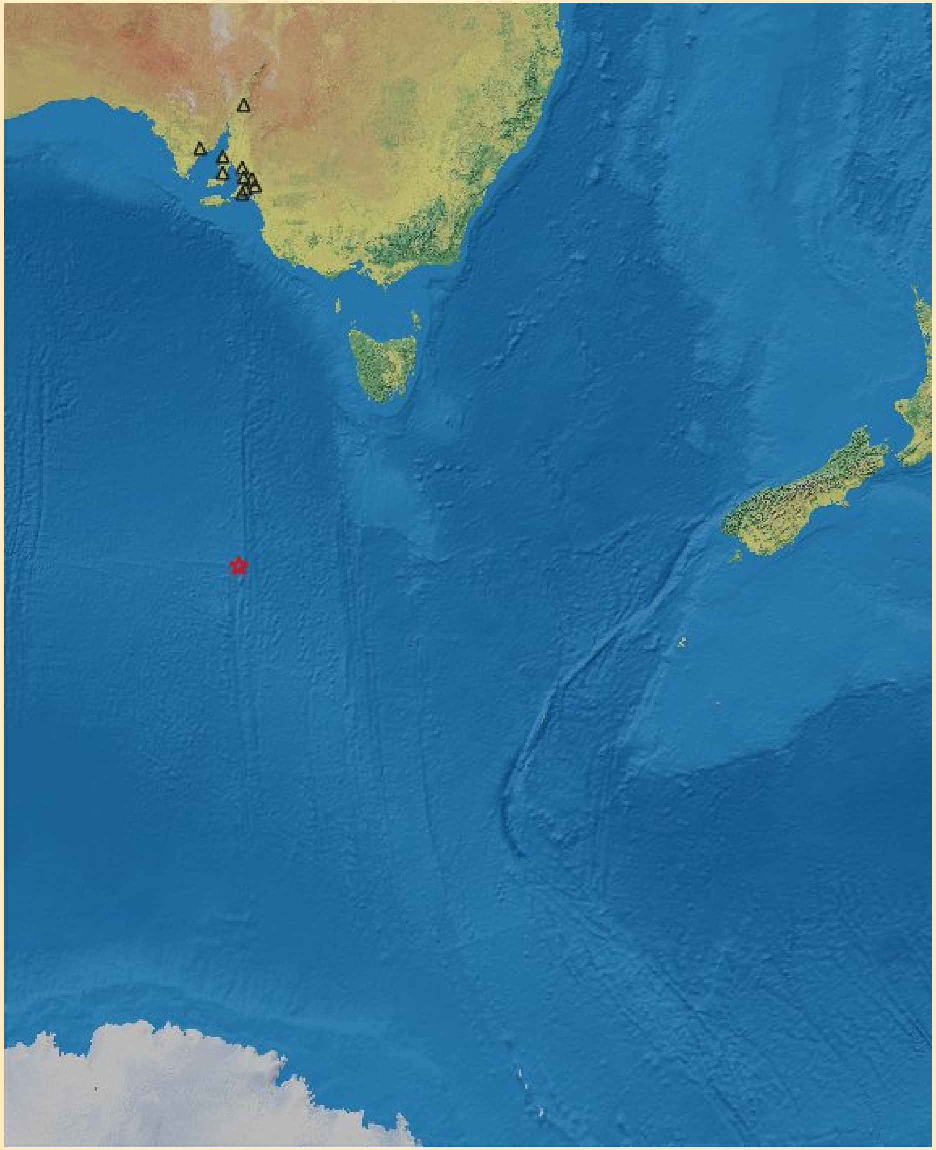


Figure 2

My very first contact with Professor Peters

Free oscillations of the Earth were predicted in 1882 by Horace Lamb and first observed unambiguously by Benioff et al for a few days, [1] following the major disturbance to the Earth's crust caused by the Great Chile earthquake of May 1960.

But it was quite by accident that in 1995 Professor Peters and M.H. Kwon were the first to observe the nearly incessant free oscillations of the whole Earth. [2]

Kwon's PhD research was concerned with adsorbed gases on solid surfaces using a Langmuir-recoil balance. Being sensitive to tilt, the instrument responded to the Earth's free oscillations excited by the tidal force through anelastic relaxation. It was the fact that these oscillations were observed to be greatest during new and full moon that enabled Professor Peters to identify them as Earth's free oscillations.

In order to study these nearly incessant free oscillations of the Earth, pretty much undetectable by conventional "velocity" seismographs having an inertial mass, Professor Peters designed [3] the pendulous tilt instrument, the VolksMeter, which is inherently linear across its full range of motion, being a tilt of ± 3.55 mRad (±0.2 Degrees) with a sensitivity of 1 part in 16.7 million and a bandwidth of ~40Hz to DC.

This pendulous instrument being optimised to study nanoradian tilting of the bedrock, fully capable of recording the 52 minute periods of the free oscillations of the whole Earth, the 12 ½ hour flexing of the bedrock under the tidal influence of the sun/moon, and capable of recording the distinctive flex pattern of the Earth's crust during each month from the changing relative positions of the sun and moon relative to the Earth.

In my discussions with Professor Peters it soon became apparent that none of the sensitive VolksMeter tilt meters in operation at that time, were functioning at their designed capabilities, because none of them were housed in an appropriate seismic vault. This was thwarting scientific investigation.

So, after many technical discussions, a seismic observatory was begun to be built late 2013 near to Victor Harbor, especially designed for research into the observation of Earth's free oscillations. It has a 3 tonne seismic pier poured on excavated hard bedrock, with the seismic vault buried under 9 metres of soil giving a temperature change of less than 0.3 degrees C in any one month of the year.

Officially opened on the 27th March 2015, it was named The Peters Seismological Observatory (TPSO) in honour of Professor Peters and the contributions he had made to the science of seismology.

Some two years later upon the formation of the Seismological Association of Australia Inc., Professor Peters became a founding member.

My very first contact with Professor Peters

In the ensuing years, two VolksMeters, and eventually a Lippman tiltmeter on the seismic pier of TPSO, provided high resolution tilt data, along with other conventional seismometers being on the same pier.

As can be imagined, when trying to record tilting over year long periods at the nanoradian level, the thermal instability of the instruments, and particularly the instability of the electronics, causes “noise”, off-sets and uncertainties to be introduced into the data. As well, local events including the ocean tides (seven kms away), the passage of deep low pressure systems, and on one occasion the overnight filling of the farm dam just 150 metres from TPSO, all impacted the tilting.

A number of unknown effects were observed in the long-term tilt records. For example, over a few years the Lippman tiltmeter showed a small but constantly increasing tilt to the NNE. Was this the settling effect on the local bedrock from the placement of 1,000’s tonnes of earth over the vault? This tilting to the NNE was about an order greater than any reasonably expected long term geological tilting of the local crust. It was only when the Lippman tilt instrument was removed for scheduled maintenance that minute corrosion on the bottom of one of the brass levelling pins where it touched the concrete seismic pier was discovered, the slow growth of the corrosion over three years ever so slightly slowly swelling to slowly minutely lift this levelling pin and giving a false increasing tilting to the NNE.

Professor Peters experience in dealing with the setting up and operation of laboratory grade instruments proved to be especially beneficial in solving some of these instrument issues at TPSO.

But how do you extract meaningful information about Earth’s minute free oscillations, from data sets extending over many months and being hidden away under lots of “noise”, local earthquakes, microseisms and teleseisms, not to mention the ever-present noise from the pounding waves on the shoreline seven kms away?

Due to the size of the 10 samples per second tilt data sets, one extending over 169 days, Professor Peters found that only Wolfram’s Mathematica had both the required capacity and the required capability of doing the Fast Fourier Transfer spectral calculations on large data sets, to the required fine resolution.

In addition, Professor Peters found that conventional spectral analysis lacked the ability to present the results in a meaningful manner for research into the Earth’s free oscillations. So he developed the Cumulative Spectral Power (CSP) analysis tool, [4] which is the integration over the conventional Power Spectral Density (PSD).

My very first contact with Professor Peters

He also set about to rigorously re-examine and apply the fundamental laws of physics to understand the movement of the seismometer mass (or pendulum) under the influence of ground movements, (or as we all know, the movement of the seismometer case with the ground movements).

Professor Peters was most adamant that the commonly used term m^2/s^4 as used by engineers and as used by seismologists, to calculate the Power Spectral Density was `bad-science' nomenclature resulting in enormous confusion, and the practice ought to cease. He went on to say, that it should be noted that m^2/s^4 per Hz is not a proper set of units for PSD graphs, nor is it ever a proper specification for specific power. [5]

In his paper, “Method for estimating the average Power of Earth's Seismic Noise”, he explains the proper term for determining specific power as being m^2/s^3 .

In being so particular to get the physics correct, he was able to extend our understanding to enable the calculation of the “true” power of a mass of earth under the seismograph weighing the same as the seismometer mass, hence being able to deriving the “true” power of a kilogram of earth underneath the seismometer during the earth movements as measured by the seismometer.

“True” power according to the physics definition of power is in terms of the ‘System International’ standard of watts, Watts per kg.

Watts per kg is an important concept if you want to accurately determine total “true” power of Earth’s free oscillations, if the Earth weighs 5.7 x 10^{24} kg.

The following is an example of Professor Peters high resolution spectral analysis of TPSO VolksMeter tilt data.

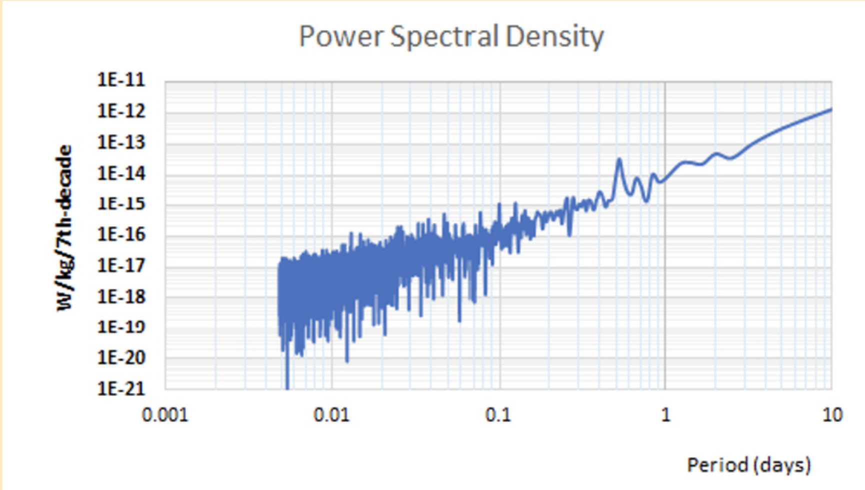


Figure 1, Conventional Power Spectral Density display – using watts/kg/7th-decade

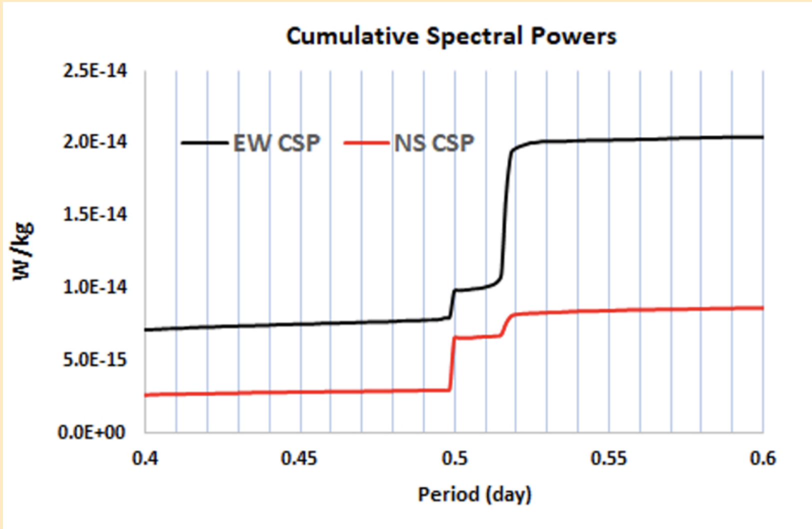


Figure 2, Professor Peters Cumulative Spectral Powers – using watts/kg

My very first contact with Professor Peters

Please note that the FFT-points [shown in Figure 3 to Figure 5] are not a 'comb' of equi-spaced frequency points joined with a line-curve. Rather, the longer the period, the farther apart the points get from each other as the period increases.

Figure 3 is included to show just what fine spectral resolution was obtained, and to show the usage of "true" power units - watts per kg.

It shows at a period of 0.500 of a day, 12.0 hour period, the effect of the Sun upon the Earth's crust.

It also shows at a period of 0.517 of a day, 12.4 hour period, the effect of the Moon upon the Earth's crust.

This is believed to be the very first-time spectral resolution has been high enough to differentiate between the effect of the Sun and the effect of the Moon upon the Earth's crust. In 2018 an online search failed to find any evidence that anybody has been able to show this.

Professor Peters stated that Figure 3 is a solid first-piece of evidence for his conclusion that the Earth does not exist in the form of a geoid that is of largely static shape, in the form of an oblate spheroid -- that bulges nicely in the manner of assumptions used by gravitational potential theory. Conventional wisdom evidently believes that the line-width of a semi-diurnal tide component is always too 'broad' to allow visibility of the component that is known to exist from the Sun; which contributes with a period of 12.0 hrs.

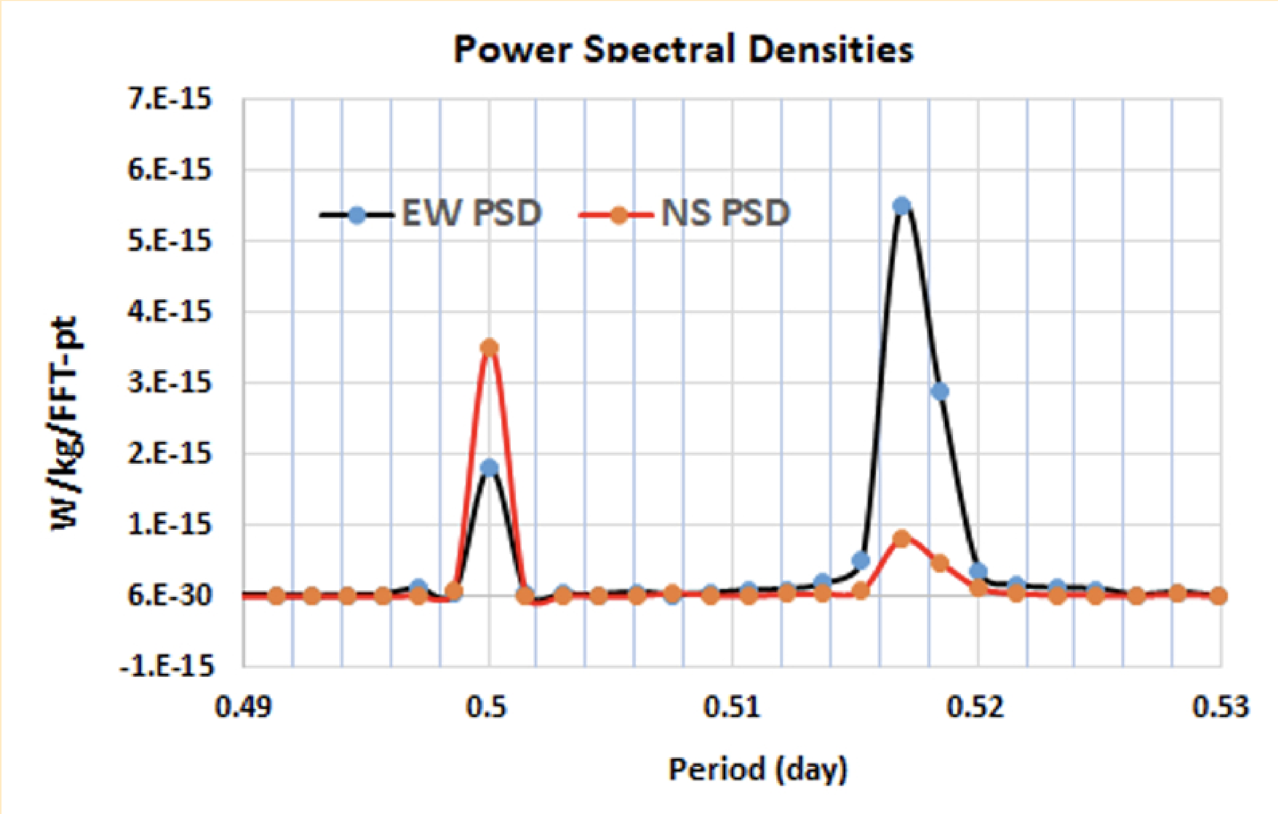


Figure 3, VolksMeter tilt spectra around the 0.5 day period. From 169 days of VolksMeter ten samples per second tilt recording at TPSO - commencing 1st January 2017. (Showing period of 11.76 hours to a period of 12.72 hours)

My very first contact with Professor Peters

These two figures again reinforce Professor Peters conclusion that the Earth is far too complex to be understood on the basis of existing theoretical methods with which crustal tide estimates are performed. Again, this is only “visible” because of Professor Peters high spectral resolution of VolksMeter tilt data taken from the seismic vault of TPSO.

Figure 4 is almost identical in spectral characteristics to Figure 3. It shows one month, with the E-W channel data being dominated by the influence of the Moon.

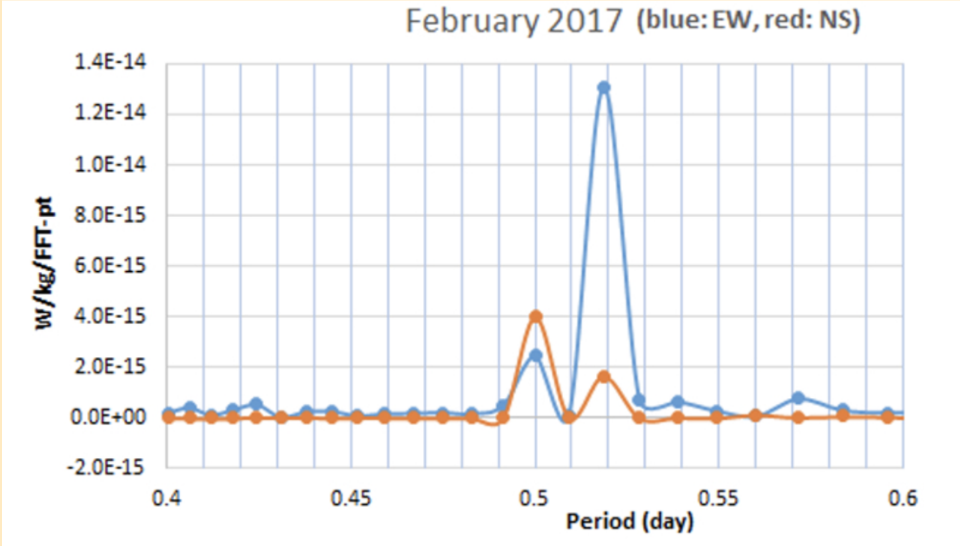


Figure 4, VolksMeter tilt spectra at TPSO for February 2017

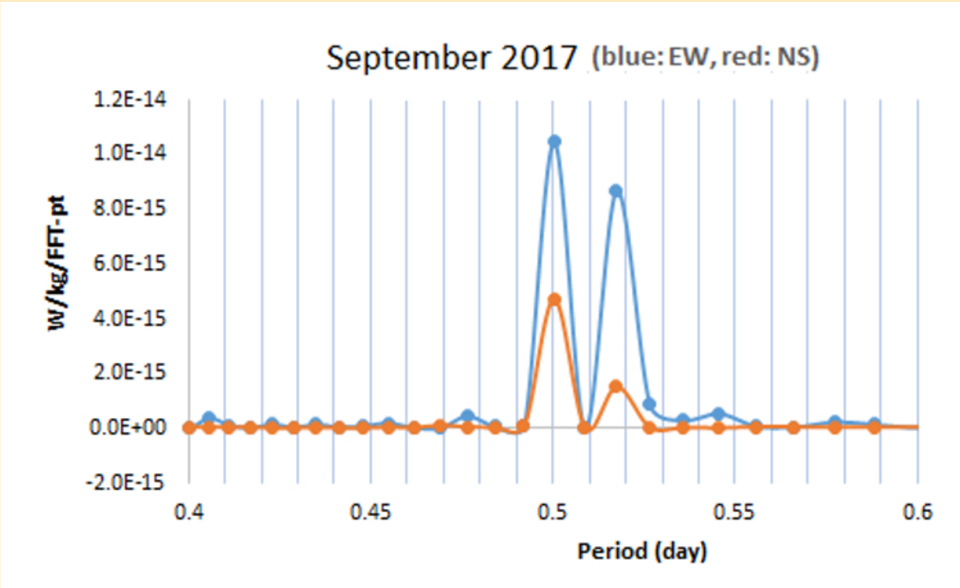


Figure 5, VolksMeter tilt spectra at TPSO for September 2017

Figure 5 is seven months after Figure 4, and shows the E-W channel data for one month being slightly dominated by the influence of the Sun.

Again, this “mode switching”, of the E-W channel data being dominated at one time of the year by the Moon and then some half a year later being slightly dominated by the Sun, is totally unexpected, and again reinforces Professor Peters view that the present-day Earth crust tidal models do not take into account the real-life complexity of the Earth.

These results, from high resolution spectral analysis of data are not unique to TPSO.

My very first contact with Professor Peters

Using European Data

Using the same careful spectral analysis of historic tilt records that were graciously given by a scientist affiliated with a well-known, long-term highly respected European observatory showed the exact same influence of the Sun and Moon. The details of that analysis remain to be published.

Two different places on Earth, one in the Northern and one in the Southern Hemisphere, seen with two totally different types of seismograph, show clearly that the Earth is far too complex to be understood on the basis of existing theoretical methods with which crustal tide estimates are performed.

Spectral analysis of Earth's free oscillations

Professor Peters showed that on a handful of occasions within the time frame of a day to hours before some major earthquakes, high resolution spectral analysis showed a classic "slowing down" of the "true" power of the Earth's free oscillations. He believed this was the very first time this had been observed.

But there was never enough long term (years) of spectral data tied to the time domain, so as to determine if such "slowing down" only occurred prior to major earthquakes or if indeed the natural ebb and flow of the total energy of the Earth's free oscillations just happened to coincide with the approximate timing of a major earthquake.

Time consuming hand manipulation of a week's data giving Cumulative Spectral Power analysis twice a day, showed not unexpected variations in "true" power over a range of oscillation frequencies.

Professor Peters was in the process of automating the analysis of the VolksMeter tilt data from TPSO, so as to give four Cumulative Spectral Power analyses each day, which would have been used to see if any correlation did exist between a "slowing down" of the "true" power of the Earth's free oscillations before major earthquakes.

With the death of Professor Peters late last year, I have not only lost a very close friend, but lost a scientist who somehow was able to delve into very complex matters of seismology yet always respected and acknowledged my role as an amateur seismologist, even to the point of insisting my name be first on some of our jointly published papers. [6]

My very first contact with Professor Peters

The seismic world has lost a physicist who was certainly pushing the known boundaries of how we understand our Earth, by his infectious enthusiasm for research and his stickling for staying with the laws of physics.

A list of his publications still is maintained by Mercer at http://physics.mercer.edu/hpage/peters.html

He is sadly missed.

Paul Hutchinson
12th August 2021

References

1__https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/JZ066i002p00605

2__M. H. Kwon & R. Peters, "The study of eigenmode types and source nonlinearity in the free earth oscillations", Saemulli Vol. 35, no. 4, 569 (1995)

3__Bulletin of the Seismological Society of America (invited) publication by Peters (2009), titled “Tutorial on Gravitational Pendulum Theory Applied to Seismic Sensing of Translation and Rotation”

4__http://physics.mercer.edu/hpage/CSP/cumulative.html

5__http://physics.mercer.edu/hpage/power.html

6__http://physics.mercer.edu/hpage/volksmeter/Response%20of%20VolksMeter%20Seismometer%20FINAL.pdf

Vale Prof. Randall Douglas Peters, 1942 - 2020

Recent Seismic Activity - New South Wales

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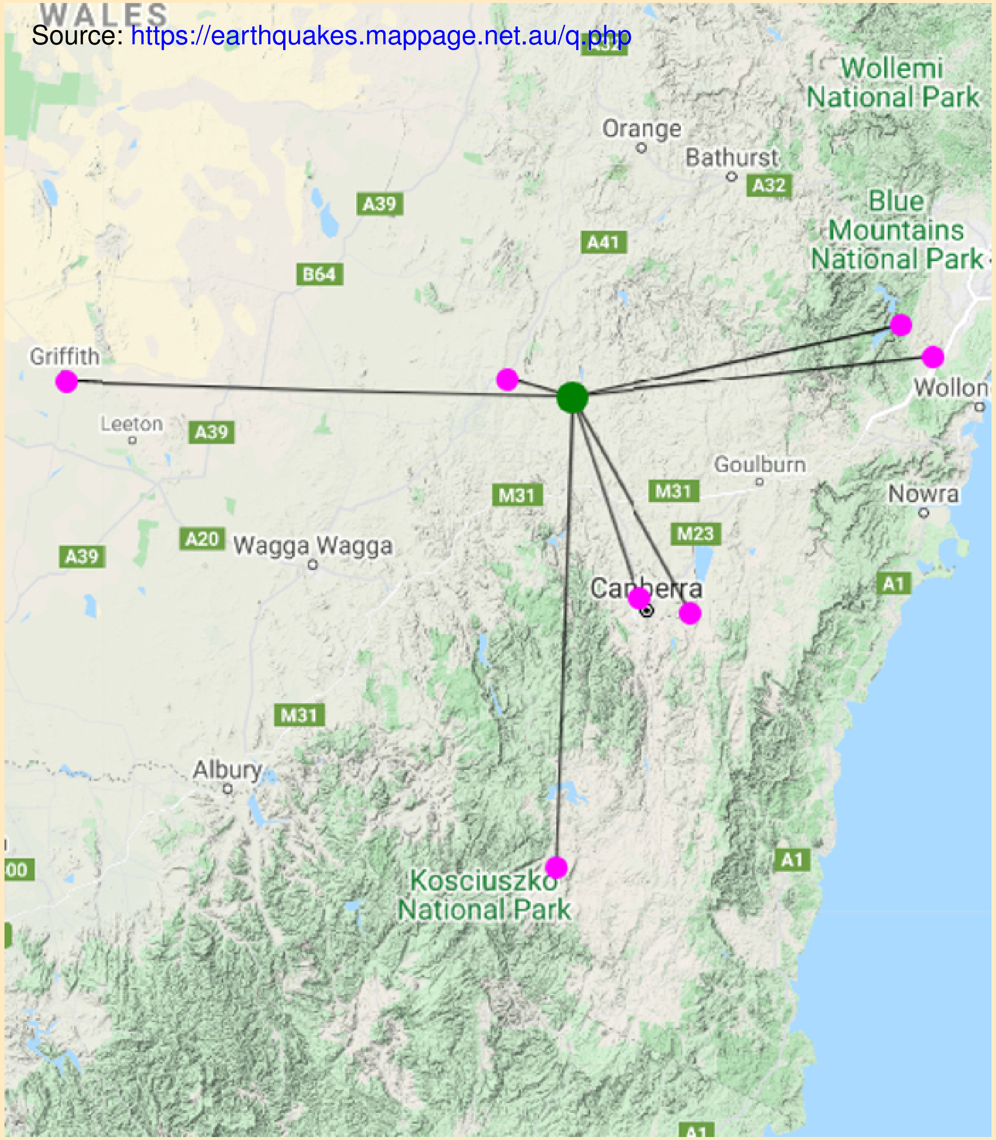
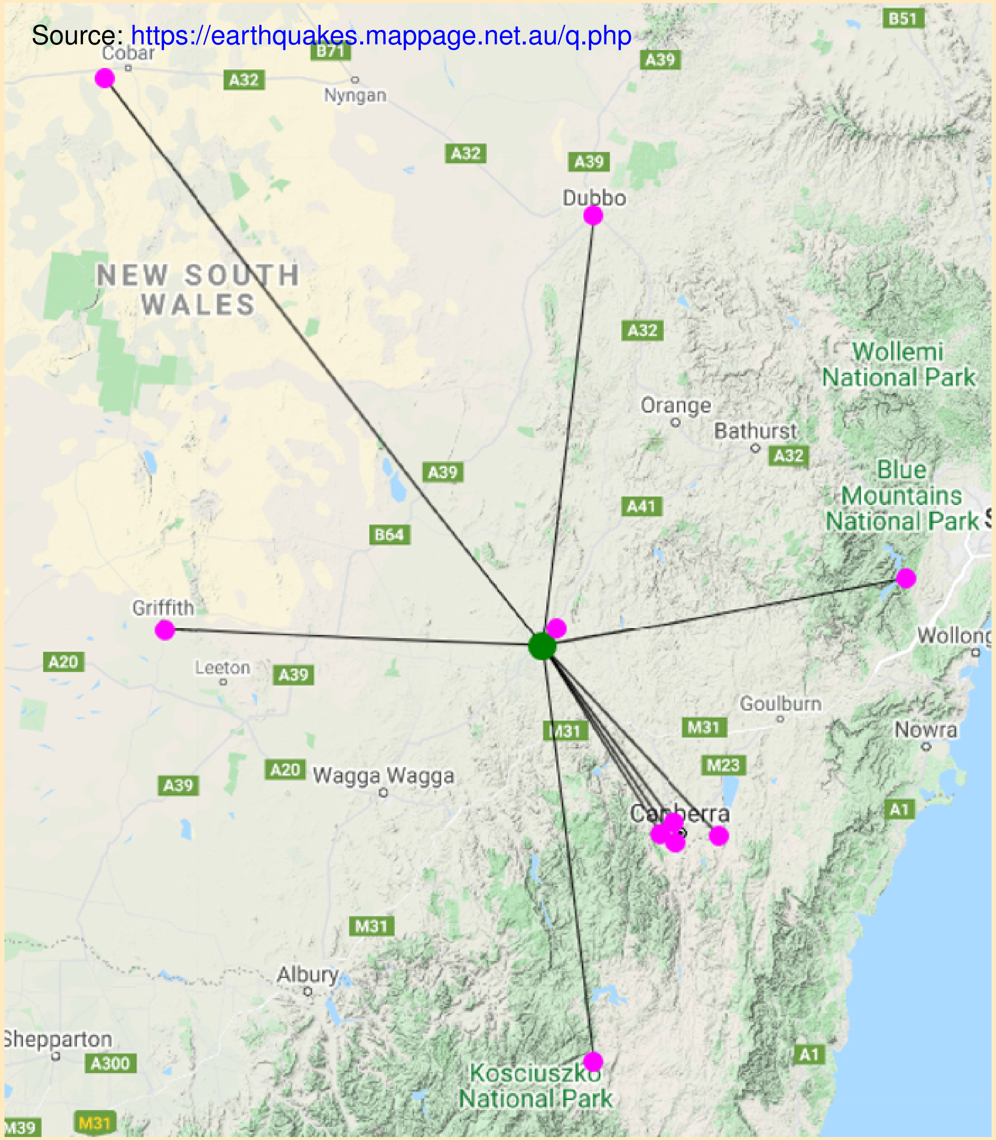
2021-08-13 20:19 N of Boorowa -34.3794, 148.728 2.0MLv

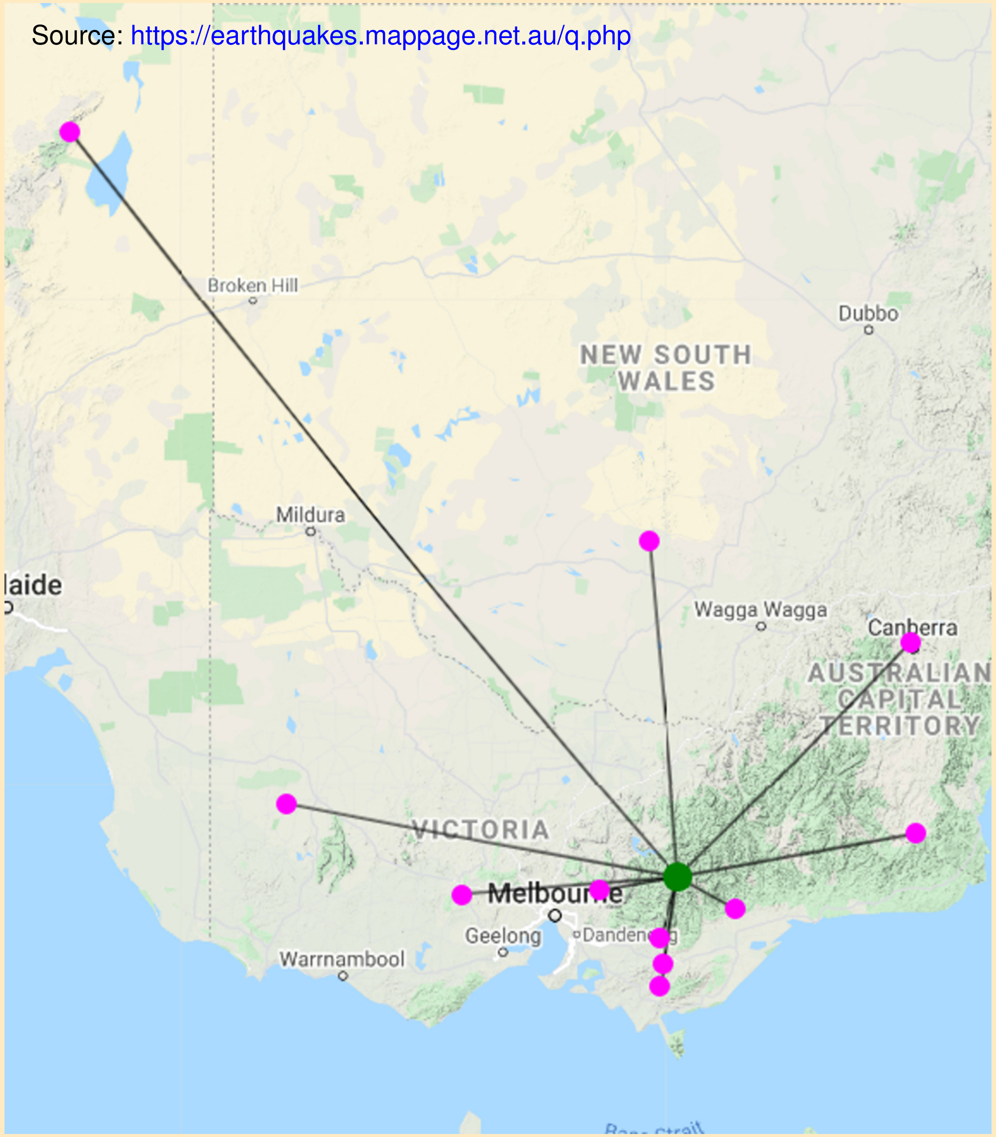


2021-08-25 13:50 S of Young -34.3933, 148.301 1.7MLv

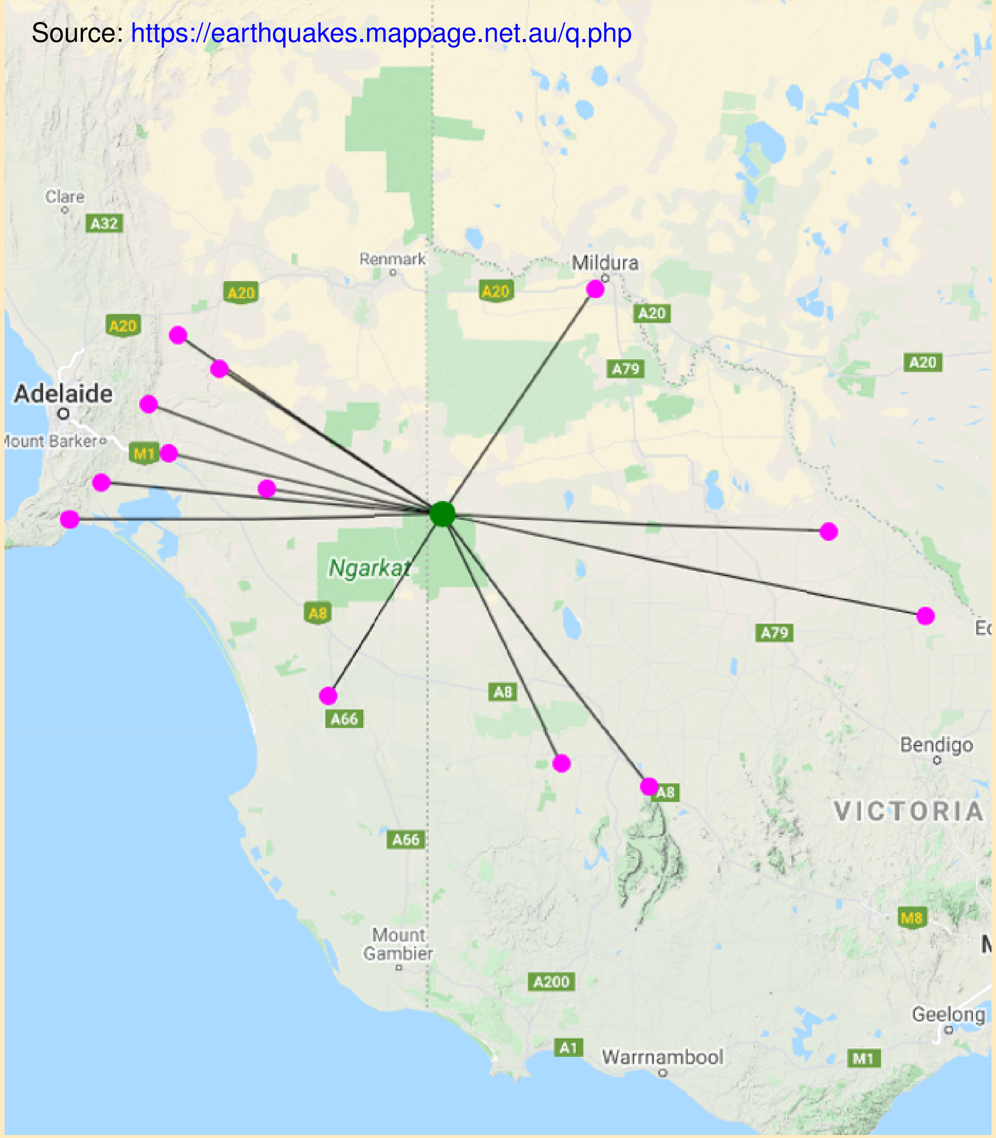


Recent Seismic Activity - Victoria

2021-09-21 23:15 Wood's Point -37.4506, 146.392 5.9MLv



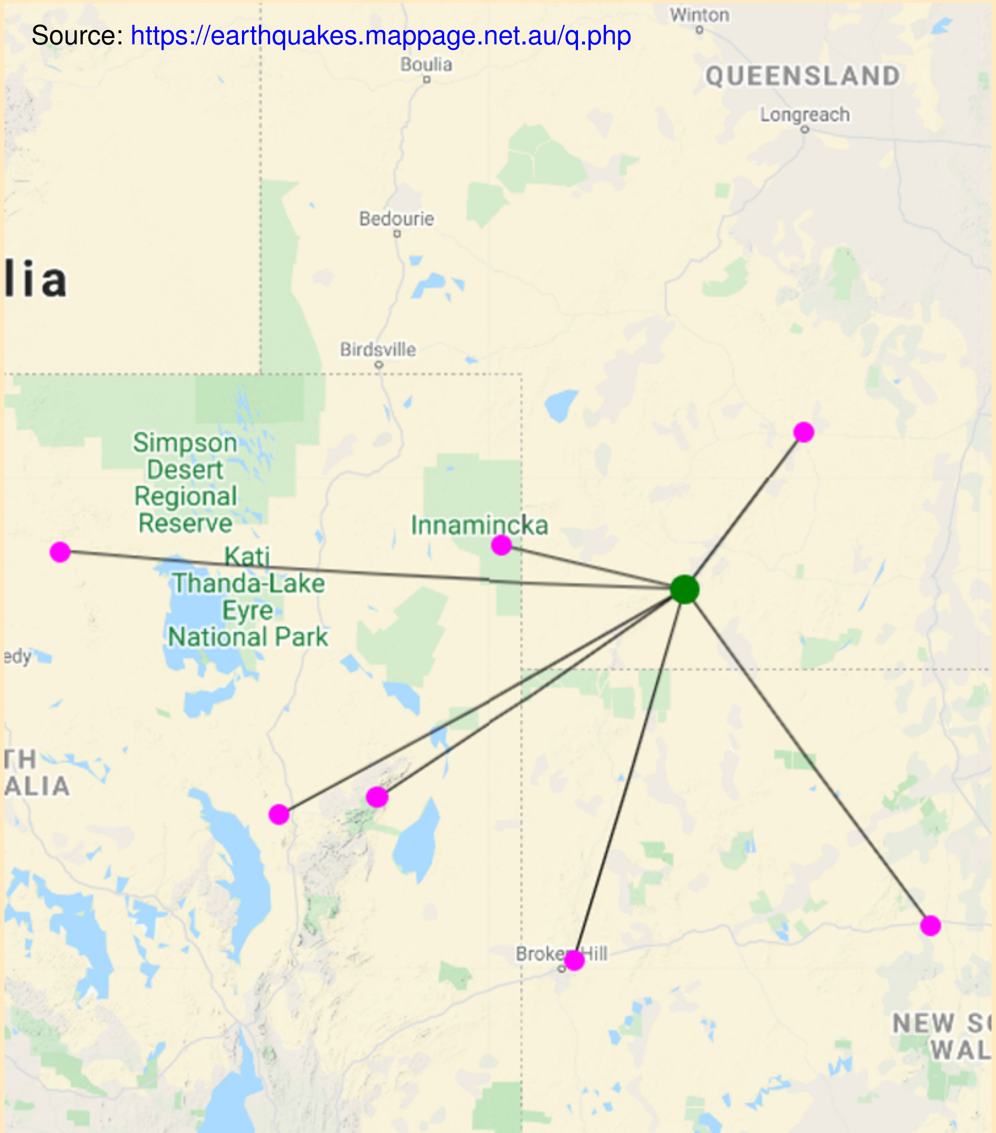
2021-10-08 16:47 SW of Murrayville -35.41, 141.02 4.8ML



Recent Seismic Activity - Queensland

2021-08-12 15:44 NE of Boulia -22.53, 140.46 3.2ML

2021-09-05 12:07 W of Cunnamulla -28.1843, 142.864 2.8MLv



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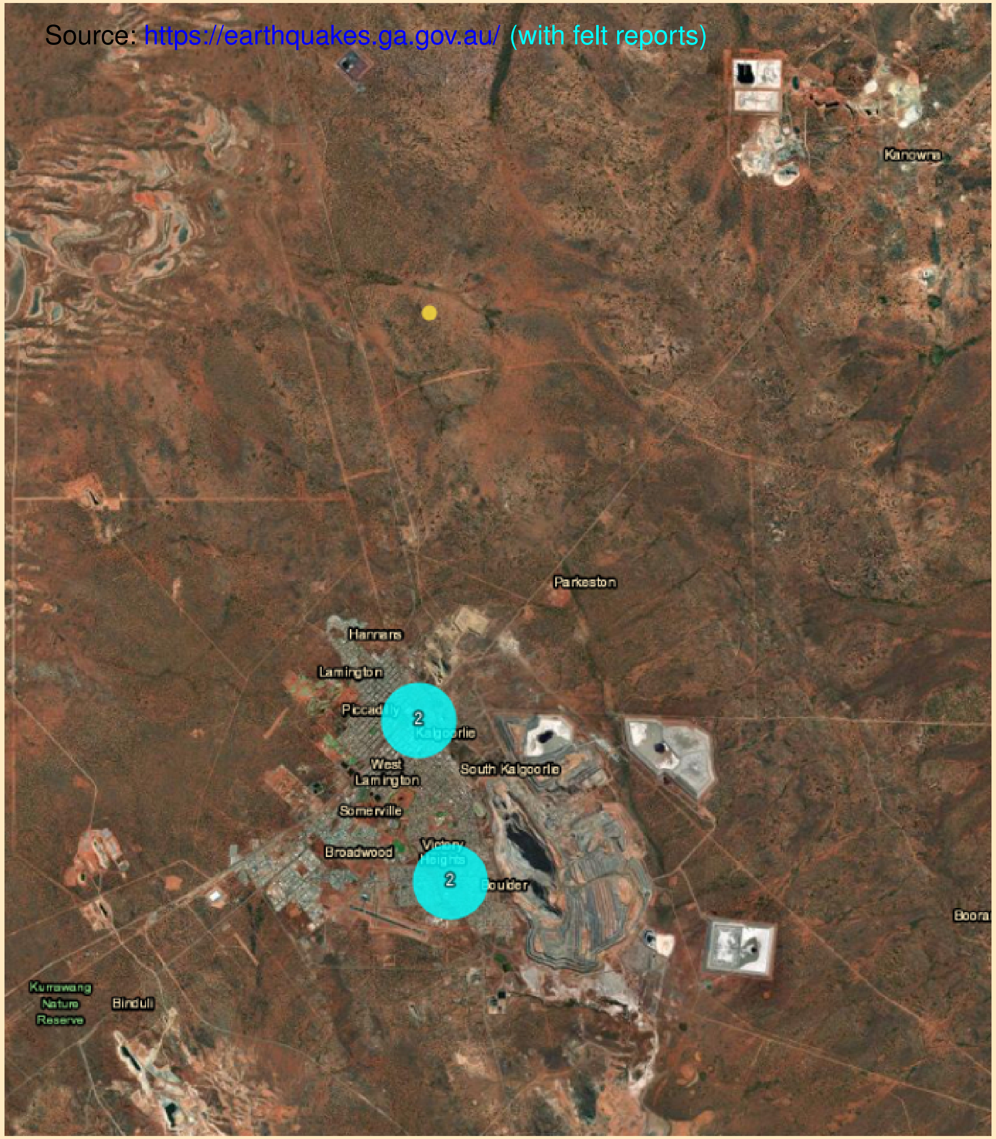
Recent Seismic Activity - Western Australia

2021-09-25 01:43 Offshore Broome -18.18, 120.29 3.8ML

2021-10-07 07:14 Kalgoorlie-Boulder -30.64, 121.48 2.8ML



Recent Seismic Activity - South Australia

2021-08-17 19:31 SE of Melrose -32.8424, 138.232 3.0MLv

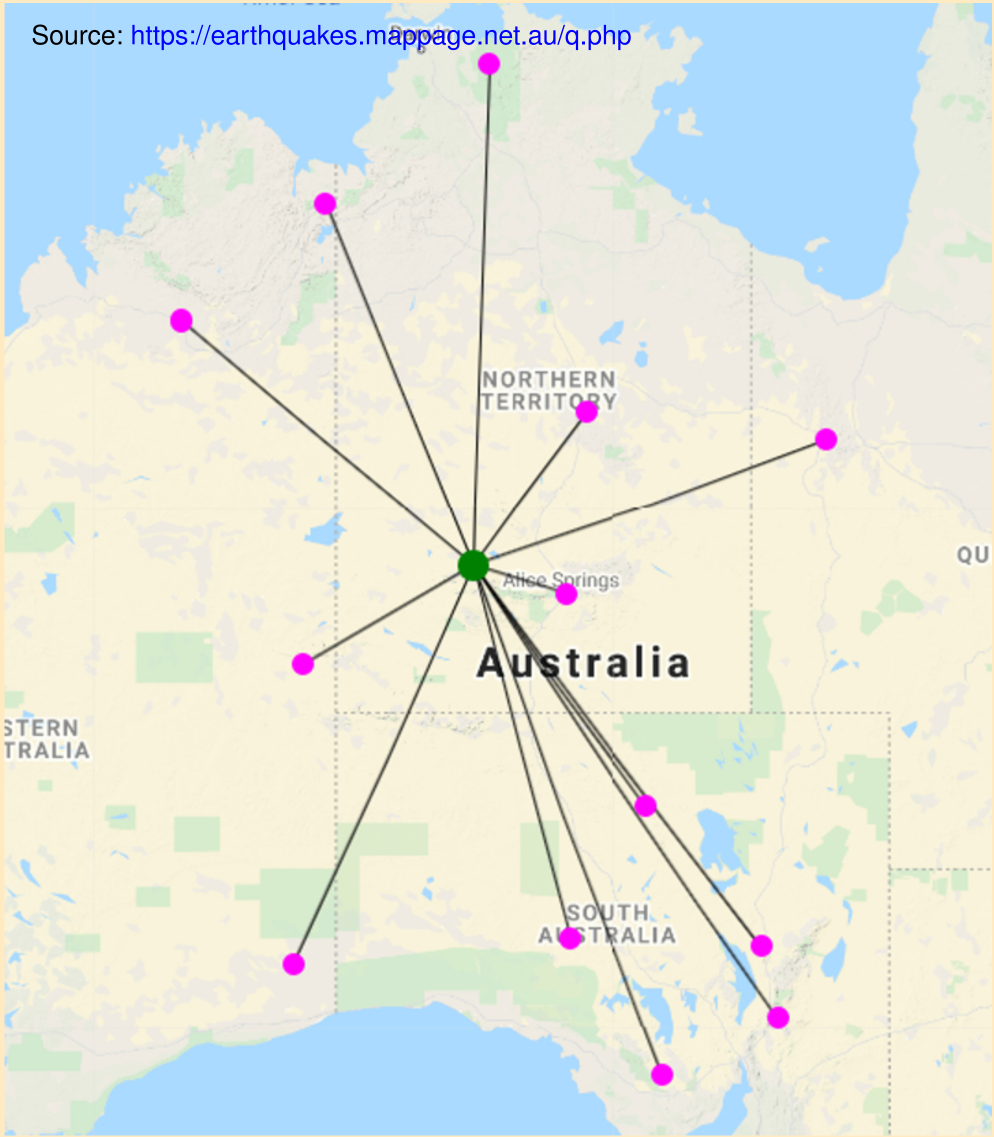
Source: https://earthquakes.mappage.net.au/q.php

2021-09-14 12:37 Wilmington -32.5478, 138.117 2.9MLv

Source: https://earthquakes.mappage.net.au/q.php

Recent Seismic Activity - Northern Territory

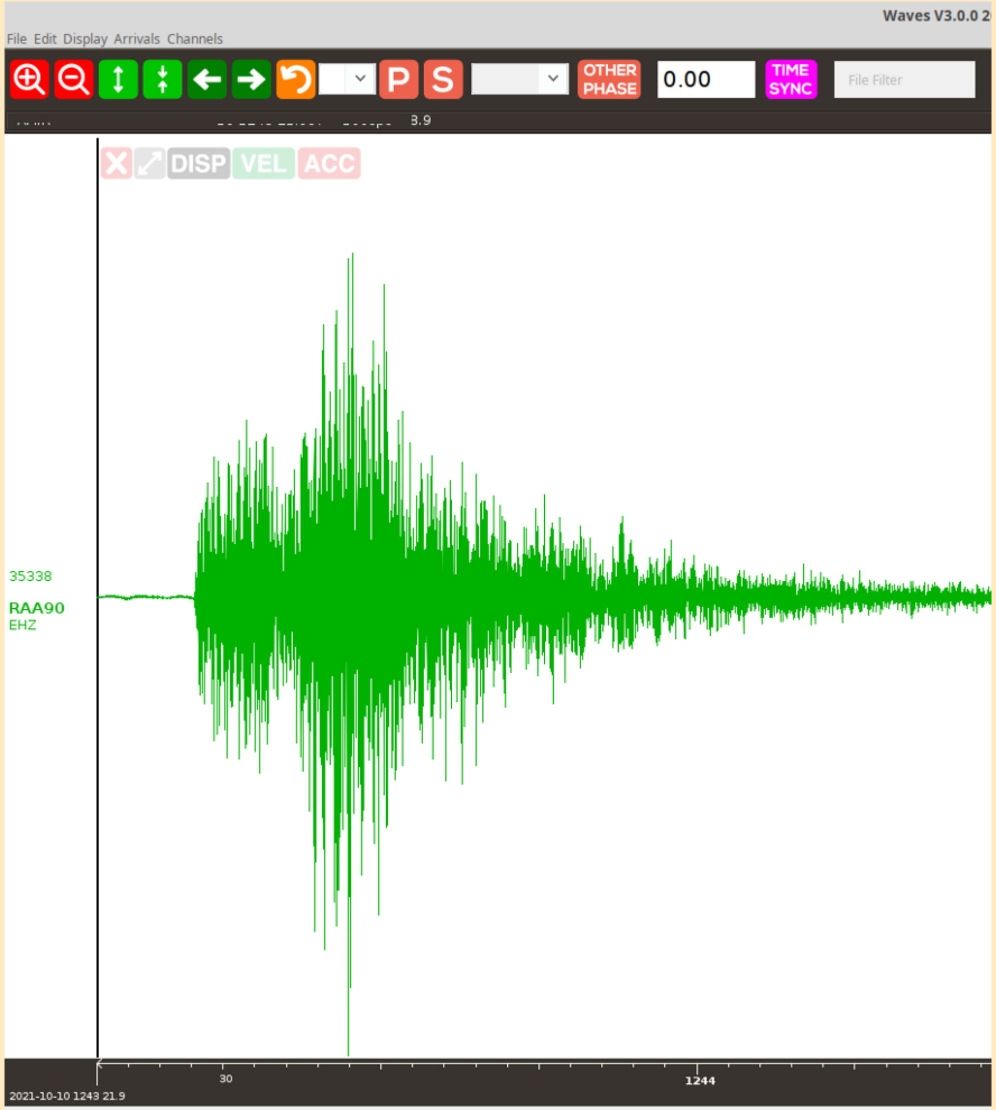
2021-08-25 13:54 NW of Alice Springs -23.0596, 131.957 3.0MLv



2021-09-09 18:42 SW of Tennant Creek -19.85, 133.91 3.0ML

Recent Seismic Activity - Tasmania

2021-10-10 12:43 NE of Swansea -41.99, 148.16 2.7ML



The Swansea quake as recorded by Tony Dow's RS4D Raspberry Shake (RAA90) approx 64km away

Haiti earthquake 2021

Kindly submitted by Kevin McCue, CQSRG
Compiled from USGS and other sources

A major M7.2 earthquake struck Haiti on Saturday morning 14 August 2021, the epicentre about 125km west of the capital Port au Prince. At least 2200 people were killed in the collapse of unreinforced or poorly reinforced masonry though that number is still rising as rescuers work through the rubble. Aftershocks recorded by the USGS to 14 August are plotted below as red dots, the mainshock is hidden below the mass of red dots but is at the centre of the peninsula at the eastern end of the sequence. Fault rupture obviously migrated from east to west. Raspberry Shake stations are plotted (coloured hexagons) near Port au Prince and in the aftershock zone and valuable data should have been collected on the mainshock.

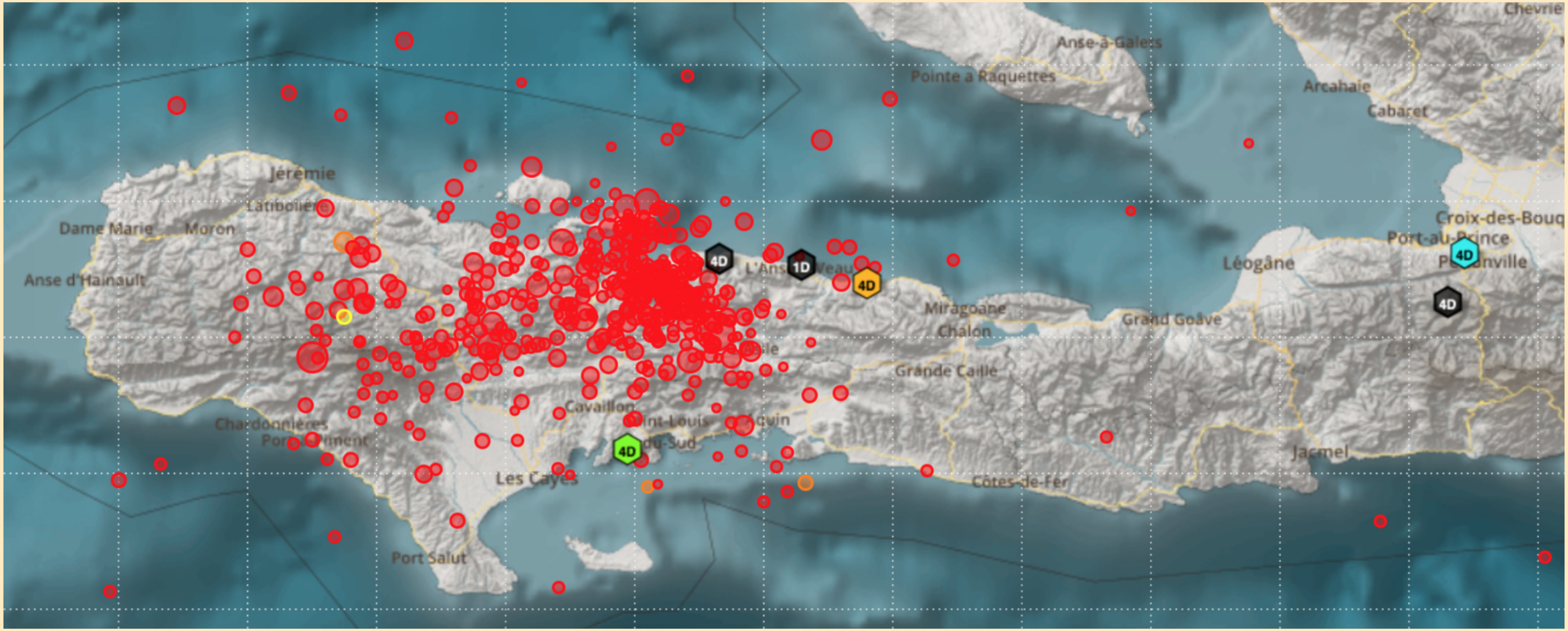


Figure 1 The aftershock sequence to 14 August 2021

Haiti earthquake 2021

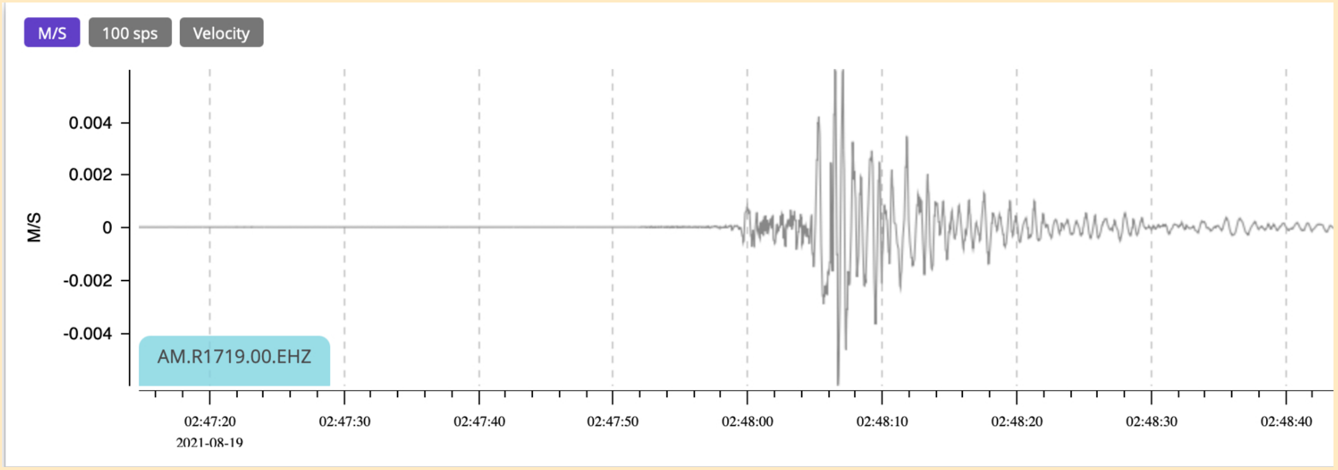


Figure 2 A typical aftershock recorded at station R1719 (orange hexagon in Figure 1)

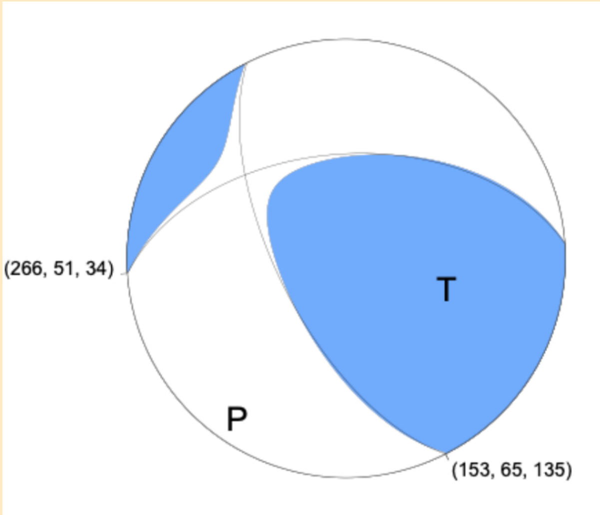


Figure 3 Focal mechanism from USGS

The main shock was predominantly a thrust and judging by the aftershock pattern the fault plane strikes NW/SE, orthogonal to the principal stress direction marked P on the USGS focal mechanism, refer Figure 3. There is considerable aftershock activity on a conjugate fault striking SW/NE (Figure 1) which is not captured in the focal mechanism of the mainshock.

This earthquake occurred on the same system of faults as the one that devastated the capital, Port-au-Prince in January 2010. A slightly smaller M7 earthquake than the recent earthquake but closer to Port au Prince, causing major damage and the deaths of 200,000 people.

Historically a series of major earthquakes, several of them tsunamigenic, devastated Port-au-Prince, in 1751, 1770, and 1860 so the 2010 and 2021 earthquakes are no surprise. What is surprising is that former colonial powers and powerful neighbours do not appear to have encouraged or introduced earthquake engineering principals in the local building industry. No lessons have been learned from history and the extreme poverty of the majority probably prevents them being enforced today. Just a few citizens own most of the wealth, amongst them a billionaire in a country that has half the population of Australia but only 25% bigger than Victoria. On 6 October 2018, a magnitude 5.9 earthquake struck northwestern Haiti, causing 17 fatalities and significant damage in the epicentral area. Only one seismic station was operating in Haiti at the time but the introduction of Citizen Science initiatives with the Raspberry Shake is changing all that and useful data should have been gathered for the first time in a large Haiti earthquake.

Haiti earthquake 2021

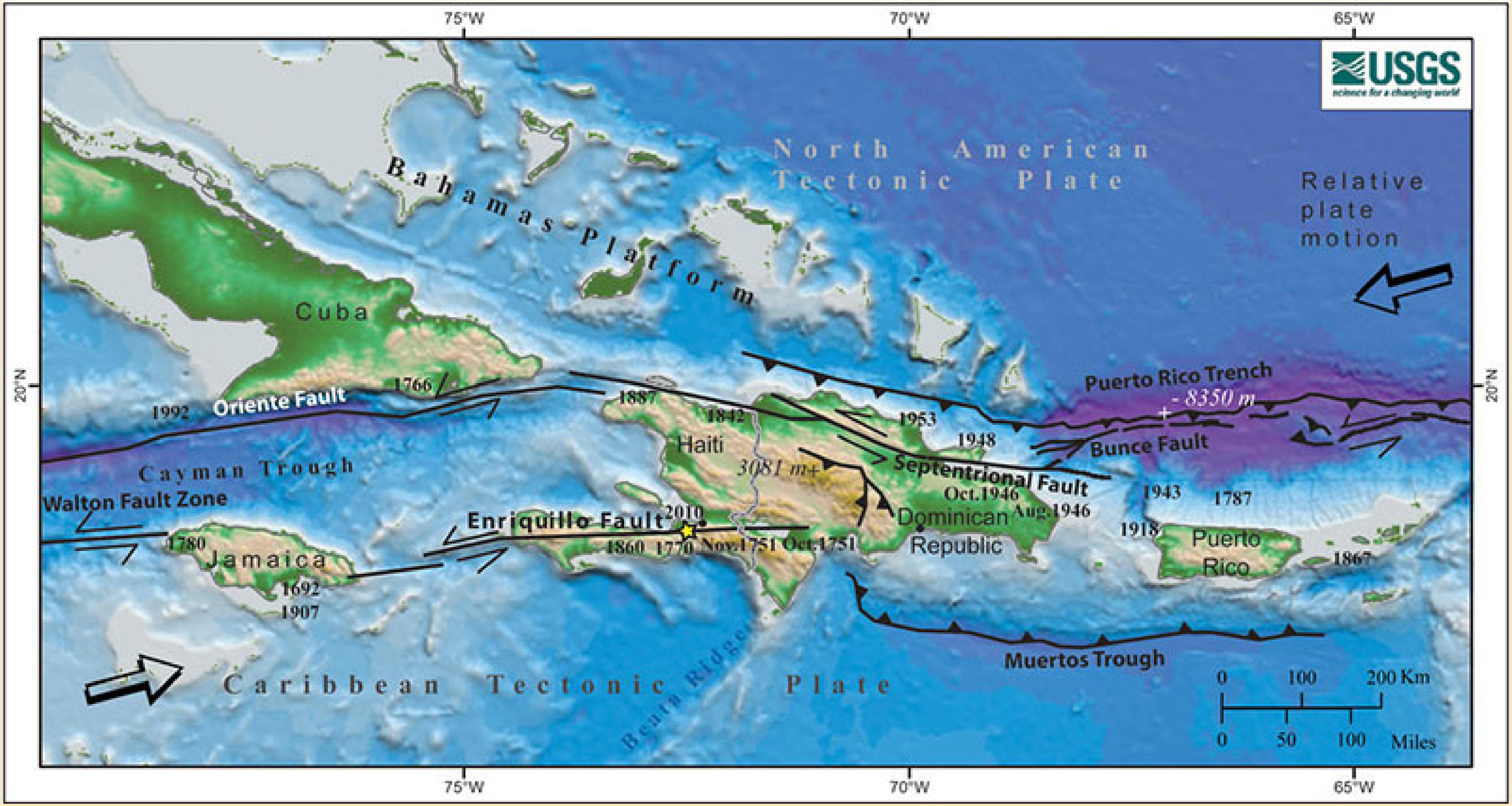


Figure 4 The tectonics of the Northeast corner of the Caribbean Plate (Map from the USGS)

Haiti earthquake 2021

This earthquake, an interplate event, is in the northeastern quadrant of the Caribbean Plate, a quite complex tectonic area dominated by the slow collision between the North American and Caribbean Plates. The island of Hispaniola, shared by Haiti and the Dominican Republic, is wedged in that zone with major transform faults along the north and southwest coasts.

We in Australia have already learned some of the lessons that should have been apparent in Haiti.

1. Close, even moderate earthquakes can cause serious damage and loss of life where unreinforced masonry is the major building material.

2. We monitor the weather with sophisticated networks of monitoring stations and earthquake monitoring is just as essential, both with seismographs and accelerographs.

3. Where tectonics or history warn of the possibility of future earthquakes, buildings should be designed and built to survive them, just as they are for wind, rain and bushfires.

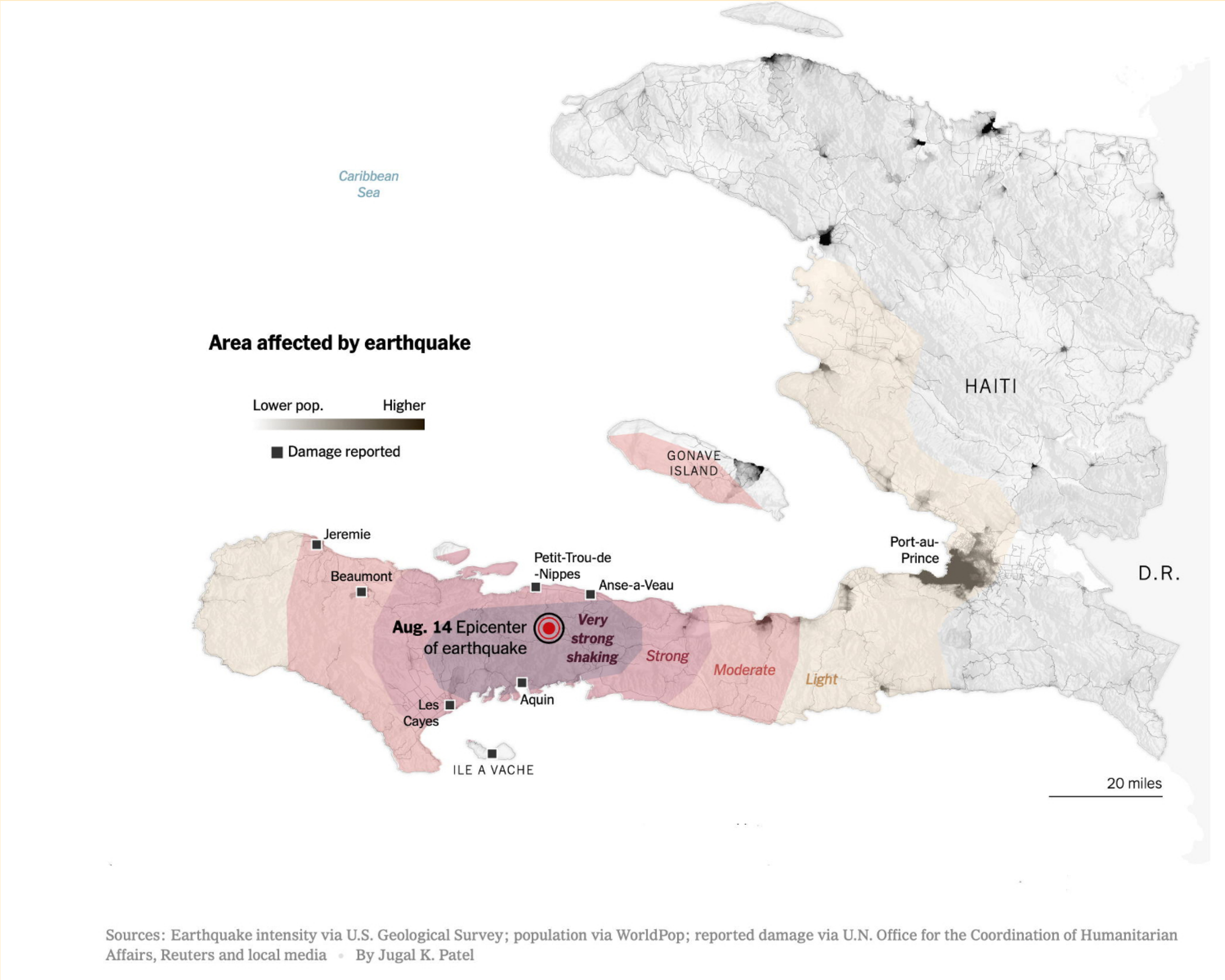


Figure 5 A quasi isoseismal map showing the epicentre, pattern of damage and shaking

Haiti earthquake 2021

Figure 6

A Haitian holding a Raspberry Shake (from Calais et al, 2019).

Note the building quality...

Reference

Calais, E., et al. (2019), Monitoring Haiti's quakes with Raspberry Shake, Eos, 100, https://doi.org/10.1029/2019EO123345 Published on 17 May 2019.

Resources & useful links

Description	URL / Webpage	Notes
SAA Membership Application	https://www.assa.org.au/media/74629/saa-membership-	Join up with the SAA using this form
SAA Flier	https://www.assa.org.au/media/74629/saa-membership-	Our current brochure - flier, saying what we do
SAA Newsletters	https://www.assa.org.au/resources/seismology/saa-	Download any SAA Newsletter from this site
SAA EqServer	http://ade-eqserver.dyndns.org:8080/eqserver/	South Australian miniseed seismometers
Melbourne University EqServer	http://meiproc.earthsci.unimelb.edu.au/eqserver/	Australian miniseed seismometers
Regional Seismic Network	http://www.regional-seismic.net/	PSN seismometers - Aust. Centre for Geomechanics
Australian Public Seismic Network	http://cqsrg.org/psn/stations/	Australian PSN seismometers
Recent SA Earthquakes	https://earthquakes.mappage.net.au/q.php	Data & summaries of recent SA quakes
Central QLD Seismology Research Group	http://www.cqsrg.org/	CQSRG - Kevin McCue
Astronomical Society of SA	https://www.assa.org.au/resources/seismology/	ASSA - Seismology page
Geoscience Australia	http://www.ga.gov.au/earthquakes/initRecentQuakes.do	Our national authority on seismic events
Earthquake Services	https://www.researchgate.net/profile/Colin_Lynam	Citizen Science Consultant - Col Lynam
Seismic Research Centre	https://www.src.com.au/	OEM of seismic instruments & software
symCDC	http://symcdc.com/	OEM of seismic instruments & software
IRIS Seismic Monitor	http://ds.iris.edu/seismon/	Global seismic events
Joint Australian Tsunami Warning Centre	http://www.bom.gov.au/tsunami/	Bureau of Meteorology site
Australian Earthquake Engineers Society	https://aees.org.au/	An organisation with similar interests
Atlas of the Underworld	http://www.atlas-of-the-underworld.org/	Mapping the Earth's mantle
Atlas of Living Australia	https://www.ala.org.au/	A Citizen Science initiative